# Do High Debt Payments Hinder Household Consumption Smoothing?

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ABSTRACT

Over the past fifteen years, U.S. households have committed a rising share of their disposable personal income to required principal and interest payments on household debt such as mortgages, automobile loans and credit card balances. This rise in the household debt service ratio (DSR) has generated interest of late because it could potentially cause households to cut back on their spending. This direct link between household debt and consumption has been studied in the literature, but the results of these studies are mixed—perhaps because debt may not have a direct effect on consumption growth, but rather may alter the relationship between consumption and income. We explore this possibility by comparing the consumption smoothing behavior of households in the Consumer Expenditure Survey over the DSR distribution. Our approach has two advantages relative to the existing literature. First, it avoids the most obvious source of endogeneity between debt and spending by studying the indirect effect of the DSR on the ability to smooth consumption through income fluctuations. Second, this approach is to our knowledge the first serious look at household-level DSRs, which vary substantially both across time and households. Our results indicate that households with relatively high DSRs are no less able to smooth through income fluctuations than other households.

**Introduction**

Over the past fifteen years, U.S. households have committed a rising share of their disposable personal income to required principal and interest payments on household debt such as mortgages, automobile loans and credit card balances. This share, also known as the debt service ratio (DSR), equaled 14 ½ percent at the end of 2006, 3 ½ percentage points higher than it was at the end of 1991 (chart 1). What caused this rise and what are the potential consequences? First, the DSR rose in part because declines in interest rates over the decade ending in 2006 spurred the demand for debt, which all else equal will raise the DSR.[1] Second, the increase in the DSR may reflect the extension of mortgage and consumer credit to households who could not previously qualify (Johnson, 2005; Dynan, Johnson and Pence, 2003). Finally, the increase in the DSR may reflect changes in the credit card market. As more households use their credit cards as a convenient payment method, the increase in short-term, interest-free loans associated with convenience use may increase the DSR (Johnson, 2007).

Chart 1: Aggregate Debt Service Ratio (DSR)
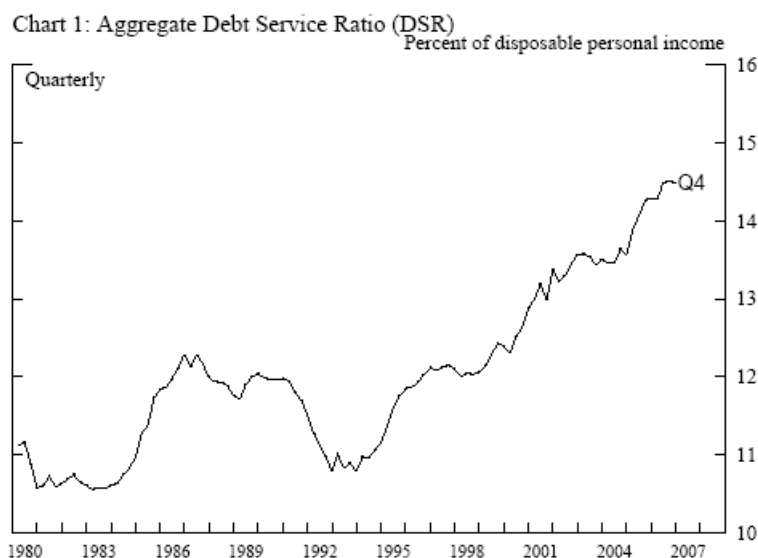


This rise in the DSR has generated interest of late because it could potentially cause households to cut back on their spending. This hypothesized link has been studied in the literature, but the results of these studies are mixed. Some researchers examined the link

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[1] For a given level of debt, a fall in the interest rate will also reduce the debt payment, but this effect is small relative to the effect of a rise in debt on debt payments.

between aggregate household debt and consumption (Bachetta and Gerlach, 1997 and Ludvigson, 1999) and found that a rise in the growth of household debt raises the growth of consumption. However, over a more recent time period, Johnson (2007) found that a rise in the growth of revolving consumer debt reduces the growth of consumption. Other researchers focused on the link between aggregate payments on debt and consumption. Mishkin (1976) and McCarthy (1997) find that a rise in debt payments leads to lower expenditures on durable goods, but McCarthy (1997) and Maki (2002) conclude that it does not lead to lower overall spending. Finally, some looked at this link at the household level, studying the effect of exogenous changes in debt payments on household consumption, but their work is also inconclusive. Stephens (2005) concludes that non-durable expenditures respond to the repayment of a vehicle loan, whereas Coulibaly and Li (2006) conclude that only durable goods expenditure—such as household furnishings—respond to the repayment of a mortgage loan.

One reason for these seemingly contradictory results may be that debt does not have a direct effect on consumption growth, but rather may alter the relationship between consumption and income. In this paper, we explore this possibility by comparing the consumption smoothing behavior of households across the distribution of their DSRs. Importantly, this paper does not attempt to test whether household consumption is excessively sensitive to changes in income. Rather, we take the degree of consumption smoothing observed in the data as given and ask whether a high DSR hinders a household's ability to smooth through income fluctuations relative to a low DSR. To answer this question, we use the Consumer Expenditure Survey (CEX) because it contains comprehensive data on household-level consumption supplemented with information on household balance sheets.

Our approach has two advantages relative to the existing literature: First, because household credit is used to finance consumption, credit and consumption are jointly determined. Previous studies of the relationship between aggregate credit and consumption generally addressed endogeneity with instrumental variables; studies at the household level viewed the maturing of a loan as a plausibly exogenous source of debt

payment variation. Our approach avoids this most obvious source of endogeneity by studying the indirect effect of the DSR on the ability to smooth consumption through income fluctuations.

Second, to our knowledge, this approach is the first serious look at household-level DSRs, which vary both across time and households. Although the average DSR in our data fluctuates no more than the aggregate DSR, this smoothness masks a considerable amount of heterogeneity. This cross-section variation provides better identification than regressions using aggregate data and permits us to control for a variety of household characteristics. Also, by looking at the effect over different cross-sections of households, we can better understand the relationship between household debt and consumption. Our results indicate that households with relatively high DSRs are no less able to smooth through income fluctuations than other households.


**Related Literature**

The literature to date presents conflicting evidence about the link between household debt and consumption. Some studies have found a relationship between certain measures of debt and certain measures of consumption. Others have found no relationship at all. This literature has generally taken one of three perspectives.

The first set of papers took an economy-wide perspective and involved regressing the expected growth in various measures of aggregate household debt on the growth in various measures of aggregate consumption. Bacchetta and Gerlach (1997) observed that expected growth in mortgage and consumer credit, as well as the wedge between borrowing and lending rates in the United States, are positively correlated with the growth in nondurable goods and services expenditures. They suggest that consumption therefore plays an important role in the transmission of monetary policy because it is influenced by the cost and availability of credit. Similarly, Ludvigson (1999) discovered that a one percentage point rise in anticipated consumer credit growth is correlated with a 0.1 percentage point rise in the growth of nondurable goods and services expenditures. She also demonstrates how her finding may be consistent with significant variation in

consumer credit ceilings. On the other hand, McCarthy (1997) found only a negligible link between household credit and nondurable goods and service expenditures, but a more significant link between credit and durable goods expenditures. Johnson (2007) also observed a negligible link between household credit and total expenditures, and a negative link between growth in credit card debt and total household expenditures.

The second set of papers also took an economy-wide perspective, but focused on debt payments rather than levels of debt. The conclusions of these papers more consistently show that debt payments influence expenditures on durable goods, but these effects are not large enough to show through to overall spending. Maki (2002) ascertained that the DSR does not add information to a model of the growth of consumption that includes past growth of consumption, the growth of income, wealth and the real federal funds rate as regressors. McCarthy (1997) learned it does enter significantly into a similar model of the growth in expenditures on durable goods. In this specification, a one basis point rise in the DSR leads to a 5 basis point decline in the annual rate of growth in durable goods expenditures in the following period. Mishkin (1976) also finds a negative relationship between consumer liabilities and durable expenditures in a stock adjustment model.

The final perspective taken in the literature is that of the individual household, and here the evidence is more mixed. Stephens (2005) found that "an anticipated 10 percent increase in discretionary income due to [an auto] loan repayment leads to a 2 to 3 percent increase in non-durable consumption." In contrast, Coulibaly and Li (2006) observe that households do not increase their non-durable consumption following the retirement of their mortgage, but do increase durable goods consumption, such as home furnishings and entertainment equipment.

The evidence in the literature to date is not only contradictory, but hard to interpret because of the number of different ways debt payments may affect consumption. First, interest rates help jointly determine both debt payments and consumption. When interest rates fall, households borrow more to pull forward a portion of future consumption, creating a positive relationship between debt payments and consumption. For a given level of debt, a fall in the interest rate will also reduce the debt payment, but given the

maturity of most household loans, this effect is small relative to the effect of a rise in debt on payments.

Second, debt payments may be correlated with household consumption because they are an indicator of expected future income growth. As households become more confident that their income will rise in the future, they become more willing to commit themselves to future debt repayment. Under this hypothesis, the relationship between debt payments and future consumption is also positive.

The third and fourth channels relate to durable goods. A rise in a household's debt payments raises the probability that a household will find itself in financial distress and need to sell its durable good assets for less than their full value. Thus, households with higher debt payments should be less willing to hold durable goods and more willing to hold liquid financial assets, creating a negative relationship between debt payments and durable goods expenditures. Also, many households finance durable goods purchases with consumer credit, which allows households to better match the payment stream for these durables with the consumption of their services. Because durable goods purchases are lumpy, a surge in expenditures in one period, which in turn leads to higher debt payments, will likely result in a decline in expenditures in the following period. Thus, under this hypothesis, debt payments and durable goods expenditures are negatively related.

In the final channel, household debt payments may also be correlated with household consumption because some households are borrowing constrained. Borrowing constraints, it has been argued, can create either a positive or a negative relationship between the DSR and consumption. Some have argued that a rise in the DSR suggests that some households have reached their borrowing limit and cannot increase their consumption as rapidly as they had in the past. Others argue that a rise in DSR suggests a relaxation of credit constraints so that some households can increase their consumption more than in the past.

The five channels through which debt payments can influence consumption are summarized in table 1.

**Table 1: Channels through which Debt Payments may affect Consumption**

| Channel | Implied relationship |
|---|---|
| Interest rates | Positive |
| Expectations of future income growth | Positive |
| Durable goods | |
|    Potential financial distress | Negative |
|    Infrequent purchases | Negative |
| Liquidity constraints | Positive or Negative |

Rather than attempt to reconcile these disparate findings, we will take a perspective not yet taken by the literature. We will explore the possibility that debt payments may not have a direct effect on consumption growth, but rather may alter the relationship between consumption and income. Before we study this relationship in detail, we discuss the quality of our household-level measure of debt service and ask whether the increase in the debt service ratio over the period covered by our micro-data was broad-based.

**A Household-level Measure of Debt Service**

*Measurement of debt payments in the Consumer Expenditure Survey*

The CEX has been conducted since the early 1980's by the Bureau of Labor Statistics to provide weights for the market basket used to construct the Consumer Price Index. As part of its expenditure data collection, the BLS asks households to report its payments on household debt, including mortgages, vehicle loans and other consumer debt, which will make up the majority of debt payments in our measure. Mortgage debt payments accounts for close to 60 percent of total debt payments, vehicle debt accounts for about 20 percent and the remainder is accounted for by credit card debt.

As noted by the BLS, "consumer expenditure surveys are specialized studies in which the primary emphasis is on collected data related to family expenditures for goods and services used in day-to-day living." (BLS 2006) As such, many studies validating the CEX data focused on its ability to replicate aggregate measures of consumption, such as personal consumption expenditures (PCE) reported quarterly by the Bureau of Economic Analysis (BEA). In general, these validation studies (see for example, Gieseman, 1987;

Branch, 1994) conclude that aggregate expenditures reported in the CEX are below those reported by the BEA, but this underreporting appears fairly constant over time so that changes in consumption at the aggregate level appear to be well-captured by the CEX.

Although validation studies have been conducted on the consumption data in the CEX, we are unaware of any study that validated the CEX liability data. Thus, before proceeding, we compare household debt payments measured in the CEX with that measured in the Survey of Consumer Finances (SCF). The SCF is a triennial survey conducted by the Federal Reserve System that collects high-quality data on household wealth holding and debt balance and payments as well as very rich covariates such as household demographics and income data. We presume the accuracy of the SCF data and compare its debt payment information with that of the CEX. In general, this exercise has increased our confidence that debt payments for the major types of household debt are measured reasonably well in the CEX.

*Debt payments in the CEX and the SCF*

Many of the types of debt covered by the CEX have similar counterparts in the SCF (table 2). Both the CEX and the SCF report payments on first mortgages, home equity loans and lines of credit on the household's primary residence. However, for debt collateralized by other properties, the SCF reports only total payments, while the CEX breaks these payments down by loan type (first lien, home equity loan, etc.). Both the CEX and the SCF includes payments on vehicle loans, and the amount of credit card debt, which can be used to estimate its required monthly payment.[2] Finally, for other types of loans, the CEX reports only total payments on "other personal loans", whereas the SCF provides more detail, breaking payments down by loan type (student loans, installment loans, other lines of credit and personal loans). Because it is difficult to reconcile both the concept and measurement of the "other loans" category between the

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[2] We do not use household's reported payments on credit card debt in part because respondents are asked to include only interest payments. Thus, debt service on credit card debt is calculated using the concept employed by the Federal Reserve System in their aggregate DSR measure. That is, households are assumed subject to a minimum credit card payment of 2 ½ percent of their outstanding credit card balance.

two surveys, we include only payments on loans secured by real estate and automobiles, and credit card loans in our measure of debt payments.

**Table 2: Summary of Debt Payment Variables in the SCF and CEX**

| SCF Debt Payment Variables | CEX Debt Payment Variables |
|---|---|
| 1. Primary residence mortgages | Primary residence mortgages |
| 2. Home equity loans secured by primary residence | Home equity loans secured by primary residence |
| 3. Lines of credit secured by primary residence | Lines of credit secured by primary residence |
| 4. Mortgages, home equity loans and lines of credit on vacation homes and other properties | Mortgages, home equity loans and lines of credit on vacation homes and other properties<br>a. Mortgages on vacation homes and other properties<br><br>b. Home equity loans on vacation homes and other properties<br>c. Lines of credit on vacation homes and other properties |
| 5. Vehicle loans | Vehicle loans |
| 6. Credit cards | Credit cards |
| 7. Other consumer loans<br>a. Student loans<br>b. Installment loans<br>c. Other lines of credit<br>d. Personal loans | Other consumer loans |

Broadly speaking, the level of total household debt payments for these three types of debt calculated from the CEX sample lines up fairly well with that calculated from the SCF sample (chart 2).[3] For each wave of the SCF from 1992 through 2004, the mean of total household debt payments calculated from the CEX sample is within about 5 percent of the mean from the SCF sample for the corresponding year, with an average gap over the five SCF waves of about 3 percent.[4]

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[3] CEX respondents report payments for each quarter, whereas SCF respondents report average monthly debt payments so all payments were converted to an annual rate. In addition, we compared the CEX respondents who were first interviewed in the year corresponding to a SCF wave. Because CEX respondents were interviewed for several successive quarters, this implies that some of the CEX debt payment data may have been collected in the following year. Underlying data are shown in appendix table A1.

[4] Each of the means are weighted using sampling weights and thus represent the average debt payment for all households in the United States. For a full discussion of the sampling weights in each of the surveys, see Kennickell and Woodburn (1997) and Bureau of Labor Statistics (2007).

Chart 2: Ratio of SCF to CEX debt payments
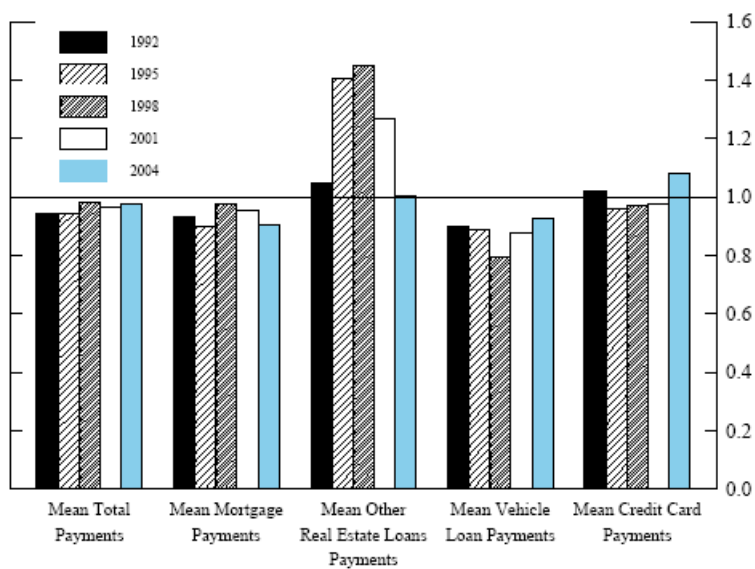


Much of the accuracy in the CEX data reflects mortgage payments on primary residences; on average over the four SCF waves, the mean of debt payments on primary residence mortgages calculated from the CEX sample is within 6 percent of that calculated from the SCF sample. The SCF data, in turn, aligns closely with that from the Residential Finance Survey, a survey in which chosen households are required by law to participate and incorporates information from lenders (Bucks and Pence, 2006). This alignment strongly suggests the mortgage payment data in the CEX are reported accurately, consistent with Froncznek and Koons (1976).

Loans for real estate other than the household's primary residence and for automobiles align less closely between the CEX and SCF. The gap between loans for other real estate calculated from the CEX and that calculated from the SCF is about 22 percent, but payments on these loans account for only about 10 percent of total payments. The gap between payments on automobile loans measured by the two surveys, which account for about 20 percent of total payments, is only about 12 percent. Finally,

minimum required payments on credit cards are closely aligned between the two surveys, with a gap of less than one percent over the five waves of the survey.[5]

Debt payments measured by the CEX sample also display patterns across demographic groups similar to patterns in debt payments measured by the SCF sample. Many of these differences across demographic groups mirror those of household income. Total debt payments in the CEX rise with the age of the household head until around age 45 and then fall steadily—a pattern mimicked by all types of debt (table 3). Households whose head is white have higher debt payments on average than those whose head is nonwhite. Debt payments also rise with education—households whose head has at least a college degree had nearly 4 ½ times more debt payments than those whose household head has less than a high school diploma. Finally, married households had over twice the debt payments of unmarried households. Each of these patterns is also evident in debt payments measured by the SCF sample.

**Table 3: Debt Payments, by demographics and household survey**

| | Total Debt Payments | | Mortgage | | Other Real Estate | | Vehicle | | Credit Card | |
|---|---|---|---|---|---|---|---|---|---|---|
| | SCF | CEX | SCF | CEX | SCF | CEX | SCF | CEX | SCF | CEX |
| Age < 35 | 7093 | 7863 | 3879 | 4634 | 544 | 344 | 2071 | 2260 | 599 | 625 |
| 35 - 45 | 11452 | 12073 | 7705 | 7961 | 717 | 810 | 2329 | 2664 | 701 | 638 |
| 45 - 55 | 12002 | 11392 | 7912 | 7256 | 1432 | 1120 | 2021 | 2237 | 637 | 779 |
| 55 - 65 | 9441 | 9652 | 5639 | 5739 | 1858 | 1414 | 1437 | 1954 | 508 | 546 |
| 65 - 75 | 5453 | 5210 | 3226 | 3461 | 1098 | 513 | 670 | 953 | 459 | 284 |
| Age > 75 | 1350 | 2676 | 711 | 1924 | 232 | 127 | 303 | 399 | 104 | 226 |
| White | 9374 | 9265 | 5932 | 5873 | 1130 | 803 | 1740 | 2009 | 571 | 581 |
| Nonwhite | 6295 | 5952 | 3759 | 3523 | 468 | 463 | 1578 | 1469 | 490 | 497 |
| Lower than HS | 3001 | 3720 | 1679 | 2300 | 231 | 163 | 913 | 1013 | 178 | 243 |
| HS | 6373 | 7164 | 3536 | 4166 | 626 | 718 | 1703 | 1814 | 508 | 467 |
| Some College | 8324 | 9220 | 4962 | 5463 | 704 | 669 | 1957 | 2428 | 702 | 659 |
| College and Above | 13514 | 13399 | 9123 | 9301 | 1774 | 1249 | 1931 | 2098 | 686 | 752 |
| Married | 11509 | 11815 | 7383 | 7597 | 1309 | 993 | 2190 | 2565 | 627 | 661 |
| Unmarried | 4219 | 5288 | 2380 | 3221 | 446 | 475 | 957 | 1149 | 435 | 443 |

Overall, debt payments in the CEX appear to be fairly accurately measured relative to those in the SCF, with debt payments for primary mortgages and for credit cards the most similar between the two surveys and those for mortgages on other real estate and automobile loans less similar.

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[5] Because credit card debt service is a constant share of credit card debt outstanding, the congruence between required debt payments in the two surveys reflects that of credit card debt outstanding.

*Debt payments in the CEX and in the aggregate*

In the aggregate, the DSR rose significantly over the period covered by our survey data. Consistent with this rise, the distribution of the DSR shifted to the right during this time (chart 3). As shown in the inset, the share of households with no debt payments has declined a bit. In addition, as can be seen, there is considerable heterogeneity across households, which will help us identify the effect of the DSR on households sensitivity to income fluctuations.

Chart 3: Distribution of DSR in the CEX
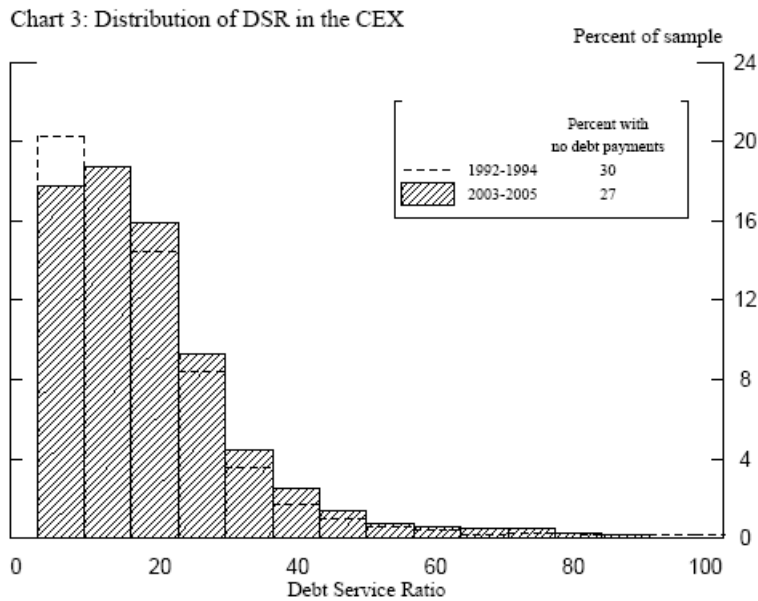


The shift in the DSR may have been related, in part, to a rise in homeownership, and the associated rise in the share of households with mortgage payments. The CEX data show that the share of households with mortgage payments increased from about 45 percent of households in the earlier years of our sample to about 51 percent in recent years. To take a closer look at the influence of the rise in homeownership, along with changes in other household characteristics, on the DSR, we regress the household-level DSR from the CE on year dummies and compare the trends from regressions with and without homeownership and other household characteristics as control variables, shown in equation 1.
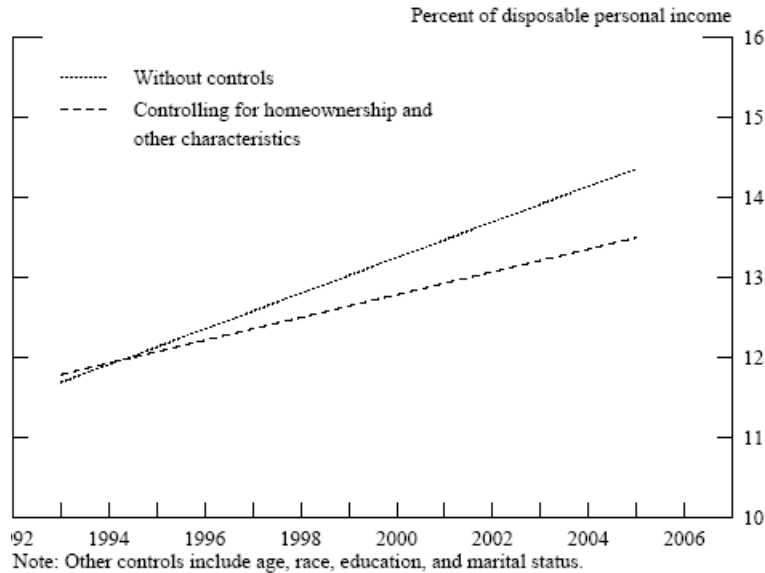
$$(1) \quad DSR_i = \alpha_0 + \alpha_1 time + \alpha_2 x_i,$$

where x is a vector that includes homeownership, age, education, marital status and race.

The dotted line in chart 4 shows the smoothed time trend in the household-level DSR without controlling for household characteristics.[6] The uptrend is broadly similar to that of the aggregate DSR over the same time period. After controlling for household characteristics—indicated by the solid line—the slope is substantially reduced but still significantly upward. All told, the remaining significant upward trend suggests that some part of the rise in the aggregate DSR over time reflects a broad trend towards higher debt service across all types of households. We now turn to how to interpret the effect of this broad trend on household spending.

Chart 4: Time Trend in the CEX DSR



Percent of disposable personal income

Note: Other controls include age, race, education, and marital status.

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[6] We smoothed the time trend by regressing the year effects on time and plotting the regression line.

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**Conceptual Framework and Model Specification**

Our framework for analyzing the effect of debt service on consumption smoothing is a standard model of the sensitivity of consumption to income changes. Assume households maximize discounted sum of lifetime utility,

$$(2) \quad \max \sum_{t=0}^{\infty} \delta^t U(C_t, \theta_t) \; ,$$

subject to the constraint

$$(3) \quad A_{t+1} = A_t(1+r) + Y_t - C_t \qquad -\infty < A_t < +\infty \; ,$$

and a transversality condition

$$(4) \quad \lim_{T \to \infty} A_T \geq 0 \; ,$$

where $\delta < 1$ is the discount factor, $C_t$ is period t consumption, $\theta_t$ is a scalar function of a household demographic characteristics vector that would affect the marginal utility, $A_t$ is net assets, which are negative if the household is a net borrower, and $Y_t$ is labor income. Further assume that households have constant relative risk aversion (CRRA) preference and the utility function is given by

$$(5) \quad U(C_t, \theta_t) = \frac{C_t^{1-\rho}}{1-\rho} \times e^{\theta_t} \; ,$$

In an economy with complete information and perfect financial markets, the first order condition of households can be written as the Euler equation

$$(6) \quad \Delta \log(C_t) = \beta_0 + \beta_1 \, \Delta \theta_t \; ,$$

where $\beta_0$ and $\beta_1$ are linear functions of the parameter in equations (2) – (5). Although these assumptions imply that consumption growth is correlated only with demographic changes and not with income growth, econometricians have typically studied the model below that nests equation (6) as a special case.

$$(7) \quad \Delta \log(C_t) = \beta_0 + \beta_1 \, \Delta \theta_t + \gamma \, \Delta \log(Y_t) + \varepsilon_t \; .$$

15

The coefficient $\gamma$ reflects the degree that consumption is sensitive to fluctuations in current income. According to the permanent income hypothesis, $\gamma = 0$ because consumption is sensitive only to news about permanent income, and not to changes in current income. However, if the complete information and perfect financial market assumptions are not satisfied, $\gamma$ can deviate from 0. For example, $\Delta\log(Y_t)$ may contain new and unanticipated information about permanent income. The response of consumption depends on the persistence of the income changes. Typically, consumption reacts more to a persistent income change than to a transitory income change. In the extreme case, if the income shock is permanent, consumption should respond one-to-one to the income change. Consumption changes may also be sensitive to income changes because financial markets may not be perfect. A borrowing-constrained household will react even to anticipated changes in income because it cannot borrow to smooth consumption against the changes.

In this work, we recognize that household consumption can react to changes in current income for various reasons and ask whether the size of this reaction depends on the household's current debt payments. According to one hypothesis, increases in debt render households more sensitive to shocks to income (Debelle, 2004). As a household increases unalterable expenditures on debt payments, a smaller share of its income is discretionary, and it must cut back consumption in response to even small drops in income.

Although the household has borrowed to finance consumption in the past, this hypothesis presumes it has reached it borrowing limit. The presumption that some households are approaching a borrowing limit is not unreasonable. By one estimate, fourteen percent of bankcard accounts have less than ten percent of their credit card limit available (Gross and Souleles, 2002). In addition, about fifteen percent of mortgages in 2006 were within ten percent of the value of the mortgaged property (Cagan, 2007).

Have some households reached a level of borrowing that hinders their ability to smooth through future income fluctuations? To answer this question, we must change several aspects of equation (7). First, the parameters will be estimated using household-

level data, so the variables will be indexed by households, rather than by time. Second, the equation includes dummy variables for the year and month of the household's observation to capture any effect of macroeconomic and seasonal factors on consumption growth. Third, the change in income is interacted with a variable that measures the household level of debt payments. These changes result in equation (7') below:

$$(7\,') \quad \Delta \log(C^i) = \beta_0 + \beta_1 \, \Delta \theta^i + \sum_{q=1}^{Q} (\gamma_q \times D_q^{\,i}) \, \Delta \log(Y^i) + \xi \times Year^i + \eta \times Month^i + \varepsilon_i \, ,$$

where $D_q^{\,i}$ is a dummy variable that is equal to one if and only if the DSR of household $i$ belongs to the $q$th ranked group, and equal to zero otherwise. $\gamma_q$ is the $q$th DSR group-specific sensitivity to current income changes. We rank household DSRs in ascending order. For example, households in group 2 have a higher DSR than households in group 1. Thus, if a higher DSR hinders the household's ability to smooth consumption, we will observe:

$$(8) \quad \gamma_{q_1} > \gamma_{q_2} \qquad \text{if } q_1 > q_2,$$

suggesting that consumption is more responsive to current income fluctuations for households with a higher DSR.

Households will be segregated into DSR group according to their ex ante DSR. That is, if consumption growth is calculated as $C_{t+1} - C_t$, we use the DSR measured at time $t$, rather than at time $t+1$, to rank the households. Using the ex ante DSR alleviates the problem of the endogeneity between debt and consumption.

Importantly, this paper does not attempt to test whether household consumption is excessively sensitive to changes in income, so we will not distinguish temporary income changes from permanent income changes. We will assume that all households share the same income processes and all shocks to income are drawn from the same distribution. Thus, every income change that we observe has the same expected persistence, regardless of the identity of the household or its income history. With these assumptions, we can identify the effect of the DSR on the response of consumption changes to income changes.

Finally, we focus on the response of nondurable goods consumption to changes in income because our data measures expenditures on these goods, which, unlike durable goods, closely approximates their consumption.

## Data and Empirical Issues[7]

We will estimate equation (7') using data from the Consumer Expenditure Survey (CEX) Interview Survey. We restrict our sample to households interviewed after 1991 because prior surveys did not collect data on auto loans or credit card debt, which are important to calculate the DSR for each household. In the most recent waves of the quarterly interview survey, the BLS collected data from more than 7,500 non-institutionalized households on their monthly out-of-pocket expenditures. Each household is given an initial (first) interview that collects basic information and is subsequently interviewed once per quarter for four consecutive quarters. To estimate equation (7'), we will use the debt payment data collected during the second interview and the change in household income and consumption collected in the second and the fifth interviews.

*Sample and Variables in Regression Analysis*

Our sample is based upon all respondents to the 1992 through 2005 Consumer Expenditure Survey. We restricted our sample to observations that included valid information for consumption, income, selected household demographics and debt payments to income. We also trimmed off the top and bottom one percent of the distributions of consumption growth and income growth and dropped households whose DSR was greater than one. Finally, we eliminated most households whose head is a student or a retiree by choosing households whose head is between 24 and 65 years of age. Our final sample included 28,791 observations.

In the final sample, a bit more than half of the household heads earned only a high school diploma, a third earned a college degree, and the remainder had not completed

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[7] See the data appendix for a full description of each of the variables used in the following analysis.

high school (table 4, column 1).[8]  Household heads in the sample are on average 44 years old, about 63 percent are married and 10 percent are black.  The households in the sample had between two and three members, on average; they earned $56,000 in total income during the year prior to their interview.

   Although we dropped households with incomplete data, and those with exceptionally high debt service ratios, the final sample is not unlike the overall population of U.S. households aged 25 – 64 (table 4, column 2).  That said, average before tax household income in our CEX sample is a bit lower than that reported in the Current Population Survey (CPS).  Although a portion of this difference may be owing to our sample selection, this discrepancy is consistent with income underreporting in the CEX documented elsewhere (Branch, 1994).

**Table 4: Characteristics of CEX Respondents**

| Characteristics | CEX Sample 1992-2005 | U.S. Households Aged 25-64 1992-2005 |
| --- | --- | --- |
| Characteristics of household head | | |
| Distribution by educational attainment | | |
| Did not complete high school (percent) | 12.8 | 13.9 |
| High school graduate (percent) | 55.4 | 55.6 |
| College graduate (percent) | 31.8 | 30.4 |
| Age | 44.0 | 42.3 |
| Married (percent) | 63.2 | 66.6 |
| Black (percent) | 10.2 | 9.9 |
| Household size | 2.9 | 3.2 |
| Before-tax household income | 56,194 | 61,257 |

Note: To account for different sample sizes in each year, the CPS data were averaged
first over households in each year and then over years.
Source: Consumer Expenditure Survey, Current Population Survey

*Measurement of income in the Consumer Expenditure Survey*

   One concern is the measurement of income in the CEX.  Although no study has validated individual household income in the CEX, studies of other surveys suggest that individual income is subject to substantial over- and under-reporting (Bound, et. al.,

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[8] The proportions and means presented in this section are intended to paint a picture of the sample used for estimation, and as such are not weighted by the CEX population weights.

2001). Relevant to our analysis, differencing income increases the variance due to measurement error. If the measurement error is correlated with measured income then ordinary least squares (OLS) estimates of γ, the coefficient on income growth, will be biased towards zero, suggesting that all households well-smooth consumption through future income fluctuations.

Several studies suggest that measurement error in income growth is non-classical, so the standard correction using instrumental variable (IV) estimation is invalid. In general, these studies find that measurement error in income growth violates the classical error-in-variables assumption that the error is independent of true income growth. Gervais and Klein (2006) point out that this violation can be induced by the structure of the CEX. They argue that in a model of consumption smoothing, "true" income growth is measured over the same time period as consumption growth. However, in each CEX interview, consumption includes expenditures made over the previous quarter, while income includes earnings over the previous four quarters, so measured income growth in the CEX is only an approximation of true income growth. The particular asynchronicity between consumption growth and income growth can be shown to imply that under some income processes, the error in approximation may be negatively correlated with true income growth.[9] In addition, income validation studies of other surveys, such as the Current Population Survey (Bound and Krueger, 1991) and the Panel Study of Income Dynamics (Bound, et.al., 1994), suggest that measurement error in income growth is mean-reverting, rather than independent of the true value of income growth.

These validation studies also suggest that the bias caused by measurement error in income growth is not overwhelming. Bound and Krueger (1991) regress the "true" value of income growth on the measured value; their results imply a 23 percent downward bias in OLS estimates for men and a 15 percent downward bias for women. A similar regression in Bound, et.al (1994) imply a 23 percent downward bias in OLS estimates.

---

[9] Whether this asynchronicity is an issue depends on households' income process. If income growth is constant over time (for example $y_t = \alpha y_{t-1}$), the CEX approximation will equal true income growth and measurement error equals zero. However, if income growth is time-dependent (for example: $y_t = \alpha^{t-1} y_{t-1}$) the measurement error will be negatively correlated with true income growth.

Because measurement error in income is non-classical, we will estimate equation (6')
using OLS rather than use an IV technique, but will keep in mind the effects of
measurement error on our estimates.[10] We will, however, maintain the assumption that
the measurement error in income is independent of the household DSR.

To help ensure that the measurement error in income is independent of the DSR, we
will use expected household income in the denominator of the DSR. Expected income
equals fitted income from a regression of the income from each household's second
interview on a polynominal in the age of the reference person, family size, and dummy
variables for a non-white reference person, high school graduate, college graduate, and
interview year.[11] Using fitted income will also help ensure that our DSR measure is
independent of the household's subsequent growth in income. To see this, suppose the
DSR were calculated using debt payments and income collected during the second
interview. If income is mean-reverting, households with temporarily low income would
have both a high DSR and high income growth, creating a positive relationship between
the DSR and income growth. Using expected income avoids this problem.

**Smoothing variation in income**

*Basic result on consumption smoothing*

Recall our baseline specification:

$$(7') \quad \Delta\log(C^i) = \alpha + \beta\,\Delta\theta^i + \sum_{q=1}^{Q}(\gamma_q \times D_q^{\,i})\,\Delta\log(Y^i) + \xi \times Year^i + \eta \times Month^i + \varepsilon_i$$

with the vector $\Delta\theta^i$ comprised of the household demographic characteristics listing in
table 4. As shown in Table 5, the OLS parameters, estimated using our CEX data, appear
sensible. The estimated sensitivity of consumption to income is similar to that found by
Dynarski and Gruber (1997) and Gervais and Klein (2006); a one percentage point rise in
income leads to about a 6 basis point rise in consumption. Other coefficients have

---

[10] In an earlier version of this paper, we instrumented income with earned income, which was constructed
from the number of hours worked per pay period and the wages earned during the pay period. These
results are presented in Appendix table 3 and chart 1.
[11] The results of this regression are shown in Appendix table 2.

intuitive signs; with each additional family member, consumption grows about 7 basis points faster. Consumption grows a touch slower among households with a nonwhite household head and slightly faster among married households and households whose head earned a high school or college diploma.

**Table 5: Growth in Household Consumer Expenditures and the DSR.**
(standard errors below parameter estimates)

| | | | |
|---|---|---|---|
| Growth in income | 0.063 ** | Change in family size | 0.067 ** |
| | 0.005 | | 0.004 |
| Age of the household head | -0.011 | Non-white | -0.014 * |
| | 0.063 | | 0.007 |
| agesq/100 | 0.055 | High school graduate | 0.016 ** |
| | 0.224 | | 0.007 |
| agecu/10000 | -0.118 | College Graduate | 0.020 ** |
| | 0.343 | | 0.007 |
| agefo/1000000 | 0.088 | Married | 0.016 ** |
| | 0.192 | | 0.005 |

**5 percent; * 10 percent
Note: Adjusted R-squared equals 0.17. Full set of month and year dummies were jointly statistically significant.

*Heterogeneity in consumption smoothing, by access to credit*

Next, households with different debt service ratios are allowed to smooth consumption differently. Households are placed into six groups: the first group includes households who have no debt payments, and the remaining five are the quintiles of positive debt service.

The results of this regression are shown in chart 5. The solid line plots the income coefficient for each group of households; 95 percent confidence intervals are shaded in gray. The coefficients fluctuate in a very narrow band across the DSR groups and are not higher for higher DSR households. The p-value for the F-test of whether the coefficients

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are equivalent, shown in the inset box, indicates that the coefficients are not significantly
different from one another.

Chart 5: Sensitivity of Consumption to Income
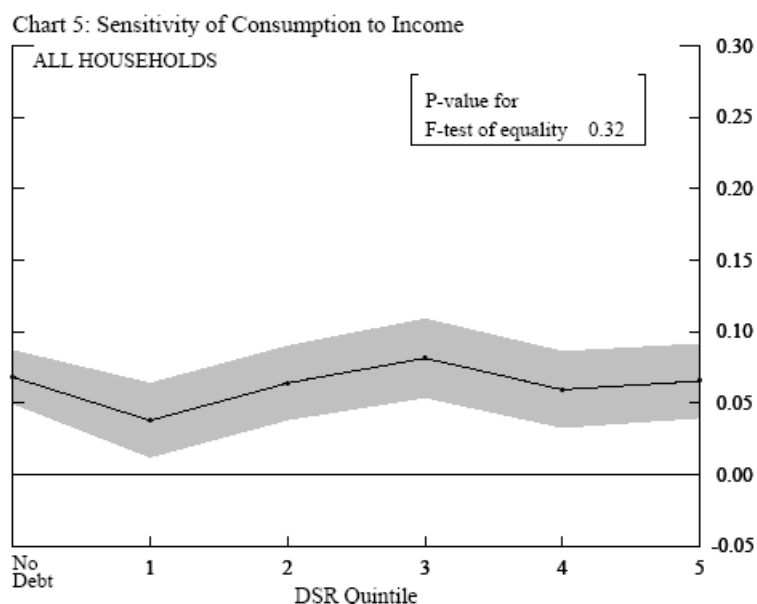


One reason the coefficients may lack an uptrend is suggested in table 6. Households
in the highest DSR group, the right column, do not look likely to be particularly credit
constrained.[12] They are slightly younger than those with lower debt service, but they
have higher income on average and nearly a quarter have a college degree.

---

[12] Indeed, households with no debt look the most credit constrained. The demographic and financial
characteristics of this group resemble those of households with a high probability of being turned down for
credit (Jappelli, 1990). Seventeen percent of households with no debt payments have a non-white
household head, compared to about nine percent of households with positive debt payments. The head of a
household with no debt payments is more than twice as likely to be without a high school diploma, and is
significantly less likely to be married as the head of a household with positive debt payments. Finally,
households with no debt payments earn significantly less income, on average, than households with
positive debt payments.

23

**Table 6: Characteristics of CEX Sample, by DSR group**

| DSR<br>Group | DSR = 0<br>No debt | Lowest 20<br>1 | Middle 60<br>2-4 | Highest 20<br>5 |
|---|---|---|---|---|
| Less than highschool education (percent) | 26.6 | 11.4 | 8.2 | 12.2 |
| High school education (percent) | 54.3 | 54.2 | 54.3 | 61.2 |
| College diploma (percent) | 19.1 | 34.4 | 37.5 | 26.5 |
| Age | 44.7 | 44.6 | 43.7 | 43.5 |
| Married (percent) | 41.7 | 58.1 | 73.0 | 61.1 |
| Black (percent) | 17.4 | 9.9 | 7.9 | 9.7 |
| Family size | 2.6 | 2.7 | 3.1 | 2.9 |
| Income | 32,426 | 43,391 | 61,247 | 77,824 |
| DSR | - | 2.2 | 17.7 | 47.1 |

To isolate potentially more vulnerable households, we repeated our analysis, focusing on the sensitivity of consumption among households in the lowest third of the income distribution. The sensitivity of consumption for these households is plotted in chart 6. Again we find that for households with higher debt service, consumer spending is no more sensitive to income fluctuations than for households with lower debt service. These results are robust to many changes in the specification, including dividing the sample into different sub-periods and separately examining income rises and declines.[13]

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[13] Results are presented in the Appendix.

Chart 6: Sensitivity of Consumption to Income

LOWEST THIRD OF
INCOME DISTRIBUTION

P-value for
F-test of equality   0.80

DSR Quintile
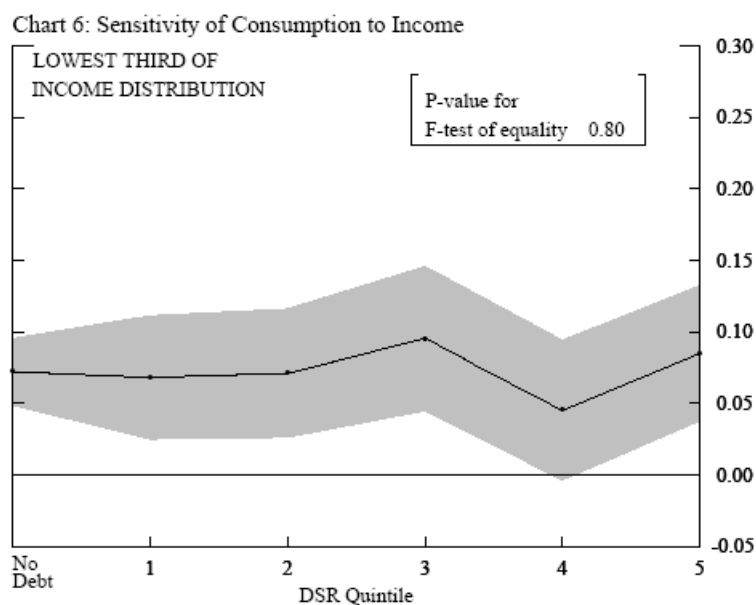
## Discussion and Conclusion

Using respondents to the Consumer Expenditure Survey between 1992 and 2005, we constructed the share of household income devoted to required payments on existing household debt (DSR). We find this household-level measure of DSR comparable to other survey data and exhibiting an upward trend that is broadly similar to a publicly-available aggregate measure of household debt service. Turning to the implications of this broad trend for household spending, we estimated the sensitivity of changes in nondurable consumption to changes in total household income across the DSR distribution. We have found that the sensitivity of changes in consumption to changes in income appears to be the same across the DSR distribution, suggesting that households with relatively high DSRs are no less able to smooth through income fluctuations than other households. One possible implication of this result is that households have not yet exhausted their ability to borrow, despite devoting a substantial share of their income to the repayment of debt. This in turn may reflect household's broad access to credit during the last decade and a half. Another implication is that households with relatively high DSRs may have sufficient liquid assets to buffer against changes in their income. Further work currently underway asks whether households with high debt service

disproportionately draw down liquid assets to smooth through a drop in income, or are they just as likely as other households to increase debt.  This analysis can strengthen our understanding of how households use assets and liabilities to smooth consumption.

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**References**

Bacchetta and Gerlach (1997). "Consumption and Credit Constraints: International Evidence." *Journal of Monetary Economics*, v. 40, n. 2, (October).

Bostic, R. (2002), "Trends in equal access to credit products," in *The Impact of Public Policy on Consumer Credit*. T. Durkin and M. Staten eds. Kluwer Academic Publishers. Boston.

Branch, E. R. (1994). "The Consumer Expenditure Survey: a comparative analysis." *Monthly Labor Review*. December. P. 47 – 55.

Bucks, B. and K. Pence (2006). "Do Homeowners Know Their House Values and Mortgage Terms?" Federal Reserve Board Finance and Economics Discussion Series 2006-3 (March).

Bureau of Labor Statistics (2006), "Consumer Expenditures and Income." *BLS Handbook of Methods*, Chapter 16. www.bls.gov/cex/home/htm.

Bureau of Labor Statistics (2007), "2005 Consumer Expenditure Interview Survey Public Use Microdata Documentation." http://www.bls.gov/cex/2005/cex/csxintvw.pdf.

Bound, J. and A. Krueger (1992) "The extent of measurement error in longitudinal earnings data: do two wrongs make a right?" *Journal of Labor Economics*, v.9, n.1, pp. 1-24.

Bound, J., C. Brown, G.J. Duncan and W.L. Rodgers (1994), "Evidence on the validity of cross-sectional and longitudinal labor market data," *Journal of Labor Economics*, v. 12, n.3, pp. 345-368.

Bound, J., C. Brown, and N. Mathiowetz (2001), "Measurement Error in Survey Data," in *Handbook of Econometrics*, vol 5. J.J. Heckman and E. Learmer, eds. Elsevier Science.

Cagan, C. (2007). "Mortgage Payment Reset: The Issue and the Impact." Research Study, First American CoreLogic. www.firstam.com

Coulibaly B., and G. Li (2006). "Do Homeowners Increase Consumption after the Last Mortgage Payment? An Alternative Test of the Permanent Income Hypothesis." *The Review of Economics and Statistics.* 88(1) p. 10-19.

Debelle, Guy (2004). "Macroeconomic Implications of Rising Household Debt." BIS Working Papers, n. 153.

Dynan, K., K. Johnson and K. Pence (2003). "Recent Changes to a Measure of U.S. Household Debt Service." *Federal Reserve Bulletin*, September.

Dynarski, S. and J. Gruber (1997). "Can Families Smooth Variable Earnings?" *Brookings Papers on Economic Activity*, 1997(1), p. 229-303.

Fronczek, P. and D. Koons (1976), "Study of Homeowners' and Lenders' Responses for Monthly Mortgage Payments, Yearly Real Estate Taxes, and Yearly Property Insurance Payments," unpublished manuscript, Department of the Census, September.

Gervais, M. and P. Klein (2006), "Measuring Consumption Smoothing in CEX Data," mimeo.

Gieseman, R. (1987). "The Consumer Expenditure Survey: quality control by comparative analysis." *Monthly Labor Review*, March. P. 8-14.

Gross, D. and N. Souleles (2002). "Do Liquidity Constraints and Interest Rates Matter for Consumer Behavior? Evidence from Credit Card Data." *Quarterly Journal of Economics*. 117 (1) February.

Jappelli and Pagano (1989). "Consumption and Capital Market Imperfections: An International Comparison." *American Economic Review*, v. 79, n. 5 (December) p. 1088-1105.
Jappelli, T. (1990). "Who is Credit Constrained in the U.S.?" *Quarterly Journal of Economics.* 105(1), p 219-34.

Jappelli, Pischke and Souleles (1998). "Testing for Liquidity Constraints in Euler Equations with Complementary Data Sources." *Review of Economics and Statistics*, v. 80, n. 2 (May) p. 251-62.

Johnson, Kathleen W. (2007), "The Transactions Demand for Credit Cards." *The B.E. Journal of Economic Analysis & Policy*, 7(1)
http://www.bepress.com/bejeap/vol7/iss1/art16

Johnson, Kathleen W. (2005), "Recent Developments in the Credit Card Market and the Financial Obligations Ratio." *Federal Reserve Bulletin*, (Autumn) p. 473-486.

Kennickell, A. and R.L. Woodburn (1997), "Consistent Weight Design for the 1989, 1992, and 1995 SCFs, and the Distribution of Wealth."
http://www.federalreserve.gov/pubs/oss/oss2/papers/wgt95.pdf

Ludvigson, S. (1999). "Consumption and Credit: A Model of Time-Varying Liquidity Constraints." *Review of Economics and Statistics*, v. 81, n. 3 (August) p. 434-47.

Preliminary, please do not quote or cite

Lusardi, A. (1996) "Permanent Income, Current Income and Consumption: Evidence from Two Panel Data Sets," *Journal of Business and Economic Statistics*, v. 14, n.1 (January) pp. 81-90.

Maki (2002). "The Growth of Consumer Credit and the Household Debt Service Burden" in *The Impact of Public Policy on Consumer Credit*. T. Durkin and M. Staten eds. Kluwer Academic Publishers. Boston.

McCarthy (1997). "Debt, Delinquencies and Consumer Spending" *Current Issues in Economics and Finance*, Federal Reserve Bank of New York (February).

Mishkin (1976). "Illiquidity, Consumer Durable Expenditures, and Monetary Policy." *American Economic Review*, v. 66, n. 4, (September).

Stephens, M. (2005). "The Consumption Response to Predictable Changes in Discretionary Income: Evidence from the Repayment of Vehicle Loans." Working paper. http://www.andrew.cmu.edu/user/melvins/

**Data Appendix – Variable definitions**

**Consumer Unit (CU)** – a consumer unit comprises either: (1) all members of a particular household who are related by blood, marriage, adoption or other legal arrangements; (2) a person living alone or sharing a household with others or living as a roomer in a private home or lodging house or in a permanent living quarters in a hotel or motel, but who is financial independent; or (3) two or more persons living together who use their income to make joint expenditures. Financial independence is determined by the three major expense categories: housing, food and other living expenses. To be considered financially independent, at least two of the three major expense categories have to be provided entirely or in part by the respondent.

**Reference person** – The first member mentioned by the respondent when asked to "Start with the name of the person or one of the persons who owns or rents the home." It is with respect to this person that the relationship of other CU members is determined.

**Consumption** –Calculated from data reported in the Monthly Expenditures (MTAB) file. In the MTAB file, expenditures reported by a CU are identified by UCC and month in which the expenditure occurred.

Consumption is assumed to equal expenditures on nondurable goods as defined in Lusardi (1996). Nondurable goods expenditure includes those on food, alcoholic beverages, public transportation, utilities, household operations, gasoline, personal care, tobacco, apparel, health care products, reading materials, educational expenses and miscellaneous from the following UCC codes:
190904, 790220, 790230, 190901, 190902, 190903, 790410, 790430, 200900, 790310, 790320, 790420, 530110-530902, 250111-270214, 270411-270904, 330511, 340210-340530, 340620-340901, 340906-340908, 340903, 670310, 690113, 470111-470212, 640130-650900, 630110-630210, 680110-680902, 620112, 710110, 790600, 880210, 360110-430120, 440110-440900, 540000-480902, 590110-590230, 660110-660210, 660900-670210, 670901-670902.

**Income before taxes** – Reported on the Consumer Unit Characteristics and Income (FMLY) file. The combined income earned by all CU members 14 years old or over during the 12 months preceding the interview. The components of income are: Wage and salary income before deductions, income or loss from non-farm business, income or loss from farm, Social Security income and Supplemental Security Income, unemployment compensation, worker's compensation and veterans' benefits, public assistance, interest on savings accounts and bonds, income from dividends royalties and trusts, pensions and annuities, income from boarders or rental units, child support, alimony, scholarships, etc., food stamps.

**Debt payments** – Payments on mortgage, auto loans and home equity loans from the MTAB file plus payments on credit card loans. In the MTAB files, debt payments

include principal and interest expenditures associated with the UCC codes for each type of secured debt.  For example, auto loans debt payments include UCC codes:

850100     Reduction of principal on vehicle loan
870103     Finance charges on loans for new cars, trucks, or vans
870203     Finance charges on loans for used cars, trucks, or vans
870803     Interest, other vehicle, financed

Payments on credit card loans equal 2 ½ percent of the outstanding balance reported in the FMLY file.

**Debt service ratio** – The ratio of debt payments to expected income.  Expected income equals fitted income from a regression of the average income from each household's second and fifth interview on the age of the reference person, age squared, age cubed, and dummy variables for non-white reference person, high school graduates, and college graduates.

**Age** – Age of the CU reference person.

**Change in family size** – Change in the number of members in the CU.

**Non-white** – Race of the reference person Black, Native American, Asian, Pacific Islander or Multi-race.

**High school graduate** – Reference person earned a high school diploma and may have some college education but did not earn a degree.

**College graduate** – Reference person earned an Associate's, Bachelor's, Master's, Professional or Doctorate degree.

**Married** – Marital status of reference person is married.

**Sample selection procedure** –
- keep only households with uninterrupted debt payments, i.e. the households have not stopped paying for one or two quarters then started paying again
- delete households living in student housing facilities
- delete households with non-positive income
- trim off the top and bottom 1 percent of log income and expenditure growth
- head of household older than 25, but younger than 64 (inclusive)
- DSR lower than 2
- valid data for family size , race, education and marital status

The final sample includes 28,791 households.

# Appendix Charts and Tables

**Table A1 Debt Balance and Payments by year and survey**

| Year | 1992 | | 1995 | | 1998 | | 2001 | | 2004 | |
|---|---|---|---|---|---|---|---|---|---|---|
| Survey | SCF | CEX | SCF | CEX | SCF | CEX | SCF | CEX | SCF | CEX |
| Mean Total Payments | 5572 | 5912 | 6137 | 6523 | 7618 | 7783 | 8616 | 8912 | 10131 | 10366 |
| Mean Total Debt Balance | 29158 | 27554 | 33518 | 34392 | 42701 | 38106 | 50342 | 46889 | 74045 | 66092 |
| | | | | | | | | | | |
| Mean Mortgage Payments | 3485 | 3749 | 3788 | 4203 | 4657 | 4761 | 5397 | 5651 | 6240 | 6918 |
| Mean Mortgage Balance | 24959 | 22796 | 28637 | 28993 | 36153 | 30880 | 42673 | 39192 | 62600 | 56931 |
| Ratio of Mortgage > 0 | 38.22% | 39.45% | 39.39% | 42.07% | 41.16% | 41.58% | 42.28% | 44.26% | 44.91% | 48.30% |
| | | | | | | | | | | |
| Mean Other Real Estate Loans Payments | 747 | 712 | 711 | 506 | 1015 | 701 | 966 | 763 | 747 | 745 |
| Mean Other Real Estate Loans Balance | 1170 | 1710 | 863 | 1194 | 1360 | 1975 | 1904 | 2149 | 4270 | 2360 |
| Ratio of Other Real Estate Loans > 0 | 13.19% | 10.86% | 11.41% | 9.66% | 14.13% | 12.64% | 12.26% | 12.64% | 14.93% | 11.71% |
| | | | | | | | | | | |
| Mean Vehicle Loan Payments | 1036 | 1155 | 1214 | 1371 | 1401 | 1761 | 1700 | 1935 | 1895 | 2046 |
| Mean Vehicle Loan Balance | 2018 | 2055 | 2605 | 2728 | 3371 | 3382 | 3927 | 3669 | 4804 | 4612 |
| Ratio of Vehicle Loan > 0 | 29.47% | 34.76% | 31.56% | 35.75% | 31.24% | 40.32% | 34.81% | 38.47% | 35.60% | 40.07% |
| | | | | | | | | | | |
| Mean Credit Card Payments | 303 | 298 | 424 | 443 | 545 | 561 | 551 | 564 | 711 | 657 |
| Mean Credit Card Balance | 1011 | 994 | 1413 | 1476 | 1817 | 1869 | 1837 | 1879 | 2372 | 2190 |
| Ratio of Credit Card > 0 | 43.70% | 45.26% | 47.26% | 48.20% | 44.10% | 49.72% | 44.38% | 44.91% | 46.17% | 42.12% |

**Table A2: Regression of Log Income for DSR Calculation.**

| Variable | Estimate | StdErr |
|---|---|---|
| Intercept | 7.717 ** | 0.260 |
| Age | 0.018 | 0.022 |
| Age square | 0.208 ** | 0.068 |
| Age cubed | -0.533 ** | 0.087 |
| Age fourthed | 0.321 ** | 0.040 |
| High school | 0.319 ** | 0.013 |
| Some college | 0.511 ** | 0.014 |
| College | 0.896 ** | 0.014 |
| White | 0.231 ** | 0.012 |
| Married | 0.505 ** | 0.010 |
| Family size | 0.069 ** | 0.004 |

**5 percent; * 10 percent

Note: Full set of year dummies were jointly statistically significant.
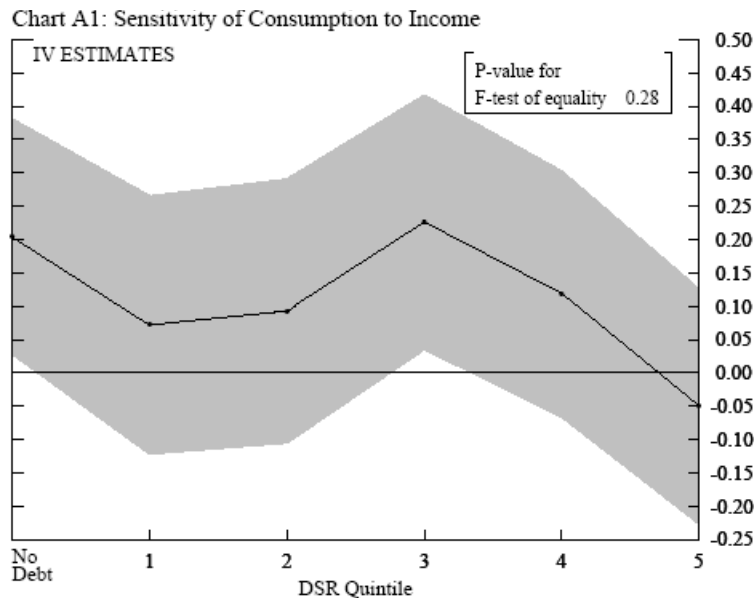
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## Instrumental Variable Estimates

**Table A3: Growth in Household Consumer Expenditures and the DSR - IV estimates**
(standard errors below parameter estimates)

| | | | |
|---|---|---|---|
| Growth in income | 0.110 ** | Change in family size | 0.071 ** |
| | 0.044 | | 0.006 |
| Age of the household head | -0.031 | Non-white | -0.020 * |
| | 0.100 | | 0.011 |
| agesq/100 | 0.094 | High school graduate | 0.021 * |
| | 0.358 | | 0.011 |
| agecu/10000 | -0.132 | College Graduate | 0.019 |
| | 0.557 | | 0.012 |
| agefo/1000000 | 0.072 | Married | 0.016 ** |
| | 0.317 | | 0.007 |

**5 percent; * 10 percent
Note: Adjusted R-squared equals 0.15. Full set of month and year dummies were jointly
statistically significant.  Adjusted R-squared of first stage regression equals 0.06.

Chart A1: Sensitivity of Consumption to Income

IV ESTIMATES

P-value for
F-test of equality   0.28

DSR Quintile

34

## Robustness of main finding

Chart A2: Sensitivity of Consumption to Income



Chart A3: Sensitivity of Consumption to Income

Chart A4: Sensitivity of Consumption to Income

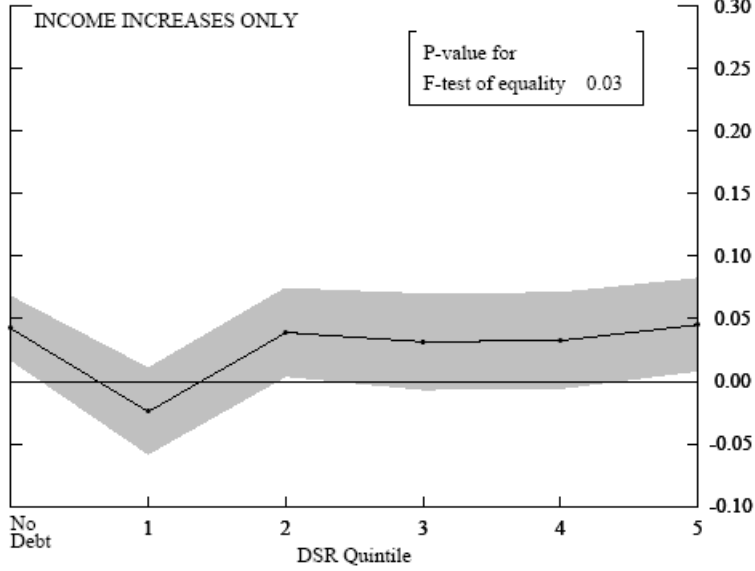INCOME INCREASES ONLY

P-value for
F-test of equality   0.03

DSR Quintile

Chart A5: Sensitivity of Consumption to Income

INCOME DECREASES ONLY

P-value for
F-test of equality   0.31

DSR Quintile

36